Domain 5:

Assisting Health Professions Education Through Information Technology

Knowledge Base of Health Sciences

Within the last few decades, powerful forces have radically changed the scope and complexity of the health sciences and the delivery of health care. These forces are continuing to influence the shape of health care, adding to and altering the body of medical knowledge, changing the way health professionals practice their craft, and modifying the system of health care delivery.

It can be argued that we are at the beginning of a new age of health care. Recent advances in medicine—particularly in molecular and cell biology, immunology, and neurobiology—have opened new paths to preventive, diagnostic, and curative strategies of astonishing power and subtlety. Progress in the fields of dentistry, nursing, pharmacy, and other health professions has yielded new approaches to maintaining health and dealing with illness.

This explosion of knowledge—combined with the aging of the population, the shift from acute illness toward chronic disease, the emphasis on cost containment, the increasingly corporate nature of health care delivery, and the availability of information processing technology—is radically changing the way health professionals function today. These factors will surely alter even more radically the way health professionals of the twenty-first century practice.

One obvious effect of the expanded knowledge base is that any single individual can master only a decreasing fraction of the total spectrum of the available information. As a result, there has been a rapid growth in the number of health disciplines and of specialties within disciplines, yielding an increasingly fragmented clinical practice.

Education of Health Professionals

Despite major advances in the science and technology of health care, and despite the new challenges to health care, the education of health professionals remains grounded in the past. The methods used to train physicians, for example, are little different today from what they were a half century ago. For all of the health disciplines, the structure of education still primarily consists of lectures in which a procession of teachers relate large quantities of scientific material to a passive student audience.

Current methods of instruction in the health sciences cannot meet the challenge of the exponentially increasing flow of new discoveries. The explosion in medical knowledge has placed impossible time demands on the curriculum and has far outstripped the ability of our students to memorize the quantity and complexity of scientific knowledge. It is not practical to increase the duration of professional education; we should not encourage the increasing trend toward narrow specialization; and we cannot depend on continuing education to fill the gap.

Information Technology and Health Sciences Education

One valid response to the problem of information overload is to take advantage of information technology to facilitate learning and to provide easy access to appropriate information sources for the practicing health-care professional. Computer-based educational applications can help users acquire essential knowledge and master problem-solving skills. Comprehensive training and experience with modern methods of information management during the students' formative years will greatly enhance their effective functioning as health care practitioners and as professionals committed to life-long learning.

In emphasizing the importance of information technology in the education of the health professional, we recognize the inherent tension between the changing and unchangeable aspects of health care. Information technology has the potential to address the ever-changing and ever-broadening mass of knowledge concerning the etiology, prevention, and treatment of disease as well as the maintenance of health. This use of technology, however important, must not distract from the fundamental human aspect of care: the relationship of an individual health professional to an individual patient.

The role for information technology concerns content, but even more importantly, concerns the method of education. Students should be given fewer answers and more tools—tools for self-teaching and for synthesizing, framing, and revising knowledge.[53] They should have the opportunity to practice, from the earliest days of professional education, the skills of seeking out information, of testing hypotheses, and of solving problems. The underlying objective in the use of information technology in health sciences education is not so much transferring current information as it is providing an environment that encourages the student to become an independent learner, capable of understanding and applying the knowledge gained.

The use of information technology in health sciences education is not a new idea. Significant advances have occurred since the early applications of drill-and-practice computer-aided instruction of two decades ago. In the interval, a number of institutions have developed prototype projects for using information technology in health-sciences education.[54] Advances in the educational applications of information technology have been made possible by a number of factors. Among them are improved understanding of the learning process and of the potential roles for the use of computer technology, more detailed specification of the information requirements in the academic and clinical settings, more powerful tools for creating computer programs, and advances in technology—all undreamed of 20 years ago. As a result, there are now very useful applications that support bibliographic retrieval, education, information management, and clinical decision making.

Finally, computer-based personal knowledge management systems can combine and integrate a number of important information resources, including: support for recording clinical information during routine care; access to knowledge bases and continuing education programs; and routine quality assurance capabilities. Those personal knowledge systems will be simply extensions of the automated aids proposed for the new health science curricula. Then the concept of life-long learning and the true continuum of health-science education will move a step closer to realization.

Goal 5.1
Develop, Demonstrate, And Assess Educational Applications Of Computer Technology In Health Sciences Curricula

At least part of the answer to the problems created by overcrowded health sciences curricula may be automated information methods. Such automated systems have the potential to encourage independent learning by the student, to spare faculty from some teaching chores, and to prepare the student for lifelong learning. An early step toward this goal is to increase awareness about the value of educational technology. Health-sciences faculty and the administration of academic health centers need to see more examples of educational technology successfully incorporated into curricula like theirs.[25]

Educational applications of computer technology currently take many forms, from simple presentation of text material to complex simulations of biomedical phenomena. In the future, computer-based patient simulations will be used extensively to facilitate the student's acquisition of skills in clinical problem-solving; to help the student learn to deal with the inherent uncertainty, ambiguities, and contradictions in clinical data; and to challenge the student to learn how to collect and interpret data.[55] All of the computer-learning activities will be available to the student at any time and from the most convenient location, whether it be within or away from the institution.

The focus of health professional education will be on training students in problem-solving, critical thinking, and analytical skills—not on memorizing factual information. There will be an equal emphasis on helping the student gain experience in how to use technology for acquiring, storing, and managing information. The evaluation of student performance will use these automated systems to focus on problem-solving rather than short-term memory recall.

The educational technology goal implies not only better means of acquiring and using knowledge, but also better means of pinpointing the individual learner's needs. Computerized methods of self-assessment can reveal areas where the student needs special help and diagnostic remedial programs can provide it. The capacity of computers to store and access large bodies of information and to call into play multimedia materials, such as high-resolution graphic displays and computer-controlled videodisk presentations, will enable individualized instruction and self-assessment.

Recommendations

5.1.1. Support the development of promising, innovative forms of information technology applications (for class instruction, patient management simulations, self-assessment and testing, etc.).

5.1.2. Promote awareness of and access to computer-based educational resources by disseminating information about existing programs and through such means as the creation of demonstration centers where faculty may observe and use applications.

5.1.3. Support the testing of computer-based learning materials both to determine their efficacy and to determine their roles in the health science curricula.

Goal 5.2:
Develop And Evaluate Prototype Knowledge Management Systems For Use By Persons In Health Sciences

NLM should stimulate the development of functioning prototype knowledge management systems and make them available to selected users, gain experience with the use of those prototypes, and obtain feedback about problems, limitations, and needed capabilities. The systems should be designed to be used directly by health professionals in daily practice and should integrate routine clinical information processing with knowledge retrieval. They should include user-interface methods and tools to facilitate targeted knowledge retrieval, browsing, and decision support.

The Library should seek additional resources to permit funding of an extramural grants program that would focus on issues related to the development of a knowledge management system for use by individual health scientists. Special emphasis should be given to:

- Understanding the information-seeking behavior and needs of practicing health-care providers.[56]
- Recognizing the behavior involved in targeted, problem-solving knowledge retrieval versus that for browsing versus that for decision support.
- Developing alternative strategies for transforming health sciences information into 'electronic textbook' formats that incorporate mechanisms for content revision as needed.
- Addressing the problems of individual versus communal authorship.
- Delineating the software engineering considerations related to the computer storage and access of large and complex health science knowledge bases.

Recommendation

5.2.1. Develop an extramural grants, special initiative program for research, development, demonstration, and assessment of knowledge management systems for use by health science professionals.

Goal 5.3:
Evaluate Possible NLM Role As Reference Resource In Support Of Automated Systems For Enhancing Learning In The Health Sciences

It is clear that instruction in the health sciences curricula, whether by traditional methods or those incorporating information systems, will inevitably be accomplished by the schools and faculty themselves. The Library cannot and should not develop standard curricular materials for use by the educational institutions. Still, it can and should provide technical assistance in the form of prototype systems, new ideas or methods, or even devices.

Many health educators have expressed a strong interest in a registry or data base that lists and describes new automated instructional support systems. Despite past difficulties in developing such listings for educational audio-visual materials, NLM could make a major contribution by attaining even partial success for computer-based instructional materials.

In addition, visual images are central to a number of research projects attempting to provide educational assistance through optical and video disk technology, sometimes coupled with relatively sophisticated computer systems. Those projects have involved initial studies in histology, neuroanatomy, pathology, radiology, rheumatology, and dermatology. They have raised substantial questions concerning the lack of technical specifications for color fidelity, image resolution, effective indexing, rapid retrieval, and transmission or dissemination. If it proves possible and practical for NLM to serve as a library of biomedical images, continued research will be required to develop the necessary specifications. Toward that end, the Library should work closely with technical specialists, subject matter experts, and medical educators.

Recommendations
5.3.1. NLM should investigate the technical requirements for and feasibility of a registry or data base of computer-based health education materials.

5.3.2. NLM should thoroughly and systematically investigate the technical requirements for and feasibility of instituting a biomedical images library.

Budget
Estimates of resources needed to implement these recommendations are given in Chapter 4.